FRED Reports

SURVIVAL, TIMING, AGE, SIZE, AND HARVEST OF CHUM SALMON RETURNING TO HIDDEN FALLS HATCHERY IN 1983

by
John A. McNair
Number 51

Alaska Department of Fish & Game
Division of Fisheries Rehabilitation,
Enhancement and Development

SURVIVAL, TIMING, AGE, SIZE, AND HARVEST OF CHUM SALMON RETURNING TO HIDDEN FALLS HATCHERY IN 1983

by

John A. McNair

Number 51

Alaska Department of Fish and Game
Division of Fisheries Rehabilitation,
Enhancement and Development

Don W. Collinsworth
Commissioner

Stanley A. Moberly
Director

P.O. Box 3-2000
Juneau, Alaska 99802

September 1985

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

About 135,000 adult chum salmon, *Oncorhynchus keta*, returned to Hidden Falls Hatchery in 1983, of which 82,600 were estimated to have been caught in commercial seine fisheries. Egg takes occurred from 19 July to 12 August, and 31 million eggs were taken for the 1983 brood. Sex ratios, coded-wire-tag retention rates, return numbers, and return timing to the rack were determined for each age class.

Survival rates for the 1977 and 1978 broods were estimated to be 1.57% and 2.42%, respectively. The survival estimate for the 1979 brood was 3.61%; this does not include the 5-year-old component returning in 1984. Coded-wire-tag returns to date show that saltwater-reared chum fry survive twice as well as freshwater-reared fry. No differences were observed between brood sources, but an early- vs. late-release scheme showed markedly better (8X) survival rates for fry released in mid-May than for those released in mid-April. Little evidence of straying was seen.

Key Words: Hidden Falls Hatchery, chum salmon, *Oncorhynchus keta*, survival, age, length, sex, harvest, southeast Alaska.

INTRODUCTION

Hidden Falls Hatchery is a state-owned facility operated by the Alaska Department of Fish and Game, FRED Division since 1979. This remote hatchery is located on Baranof Island, which is about 30 km east of Sitka in Southeast Alaska. Hidden Falls was built to enhance summer chum salmon, *Oncorhynchus keta*, commercial seine catches in northern Southeast Alaska and will produce 845,000 adult salmon by 1990. Adult chum salmon began returning to Hidden Falls in 1981. Return numbers increased rapidly, enabling Hidden Falls to be independent of wild egg takes by 1982. This report summarizes the evaluation effort for the 1983 return of adult chum salmon to Hidden Falls Hatchery.

METHODS

Chum Salmon Ripening Trial

Because a substantial number of female chum salmon arrived at the hatchery unripe in 1982, they had to be manually checked daily to prevent the waste of eggs. Fish determined to be green were sent down a pipeline that returned them to the lagoon. In 1983 adult salmon were tagged at the hatchery to determine the effects of this sorting process on egg quality and female-ripening time. During a 3-day period, 64 unripe female chum salmon were tagged with numbered jaw/opercle tags. These fish were returned to the lagoon via the return pipeline. (To eliminate any effects of gender, 10 males were also tagged and sent down the return line).

Broodstock Sampling

All chum salmon killed at the spawning rack were inspected for adipose clips (those fish on which the adipose fin had been excised before the juveniles had been released). A numbered spaghetti tag was attached to the jaw of the marked fish, and the

was sent to the Fisheries Rehabilitation, Enhancement and Development (FRED) Division Tag-Recovery Lab. Scale samples were taken approximately every day from fish killed during egg stripping so that a representative age composition throughout the run was obtained. Sampled fish were alternated daily by gender, and a sample size was usually obtained in multiples of 40 (number of scales per card). Scales were also taken from adipose-clipped fish to determine tag retention for each brood year and to verify scale aging by providing known age of fish. Lengths (mideye to fork) and weights were periodically taken to determine any size differences for fish of different ages. Brood years were referred to in European notation. Three-year-old fish from the 1980 brood were called 0.2; four-year-old fish from the 1979 brood were called 0.3; and five-year-old fish from the 1978 brood were 0.4.

RESULTS AND DISCUSSION

Chum Salmon Ripening Trial

Of the 64 jaw- or opercle-tagged, unripe female chum salmon that were returned to the lagoon, 31 (48%) reentered the raceway: two fish returned unripe, four fish returned with water-hardened eggs, three fish lost their tags, and 22 fish returned ripe (average return time of 4.7 days). Thirty three of these tagged fish were not recovered. Only five of the 10 similarly tagged males (50%) returned to the raceway (average return time of 2.8 days). This information, coupled with declining numbers of unripe females at the rack later in the run, suggested that sorting would be necessary early in the season when brood stock was limited and that by the first week in August, the process would probably not be worth the effort when excess females were present.

Egg Stripping

During 1983, 45,253 adult chum salmon were killed at the Hidden Falls rack. Over 31 million eggs were taken between 25 July and 12 August. The amount of eggs taken daily increased to a maximum of 2 million; however, the number of baskets in which the eggs were water hardened (67) became the limiting factor. Each basket contained eggs from 14 females for a total of 938 that were spawned per day. All females were sorted daily for ripeness until 7 August; all females were then killed and spawned without being sorted. On 8 August, so many fish were entering the raceways that excess females were killed and put down the excess-male chute. This helped eliminate the backlog of fish and increased the number of coded-wire-tagged fish recovered. In all, 2,390 female chum were killed as "excess." Fecundity was 2,160 eggs per female. An estimated 8,000 adult chum salmon remained unspawned in the lagoon when the hatchery egg stripping had been completed.

Straying

When no more eggs were needed, nearby streams were surveyed for the presence of newly arrived chum salmon to see if excess hatchery salmon that were unable to spawn naturally in the lagoon at Hidden Falls had strayed there to spawn. On 14 August, 2 days after egg stripping ended, Cosmos Creek (112-11-12) had 500 carcasses; only 10 live chum salmon remained in the stream out of an estimated 1,000 escapement. Since about 8,000 fish were only 2 km away at Hidden Falls, the excess chum salmon evidently strayed minimally. The 1,000 fish escapement to Cosmos Creek, however, were strays. Prior to the time when hatchery-brood chum salmon began returning to Hidden Falls, only pink and coho salmon spawned in Cosmos Creek.

Three other nearby streams were surveyed by foot on 13 and 14 August for straying hatchery fish. Clear River (112-21-5) produced no marks from the 1,500 carcasses observed, and the total escapement was estimated at 6,000 chum salmon. Ralph's Creek (112-21-6) had very few fish remaining, but one adipose-clipped fish was recovered from 510 carcasses. No marked salmon were found in 150 carcasses at Takatz River (112-11-8) where about 2,500 chum salmon were still spawning. None of the 33 unrecovered jaw/opercle-tagged fish from the ripening trial were found in the two nearby streams. Four adipose-clipped chinook salmon from Little Port Walter were killed but not spawned at Hidden Falls.

Brood Stock

Age and Size Distribution

One thousand fifty-seven scales from female chum salmon and 948 scales from males were taken and read throughout the egg stripping season. Following confirmation with the coded-wire-tag recoveries, it was determined that less than 1% of the marked salmon

scales were misread. Annual reading of scales from salmon with CWTs confirms the accuracy of the reader for all scales read. Age distribution of fish returning to the rack was 10% 0.2, 82% 0.3, and 8% 0.4. The sex ratio and age-class distribution of fish returning to the rack were applied to the numbers of fish caught in the primary commercial fisheries (Table 1). The shortened gamete-stripping period in 1983 made the evaluation of hatchery returns more difficult, since we were dependent on fish returning to the rack to represent the complete run. No practical means were available to sample the excess adults left in the lagoon. By not taking eggs from fish during the last part of the run, the 0.2s were not sampled adequately; thus, the sex ratio (1.45:1, male to female), age distribution, and number of coded-wire tags recovered were biased against 0.2 fish. Lagoon excess and fish taken in the Kasnyku Bay fishery were assumed to have a 1:1 sex ratio.

Average lengths for males were 56.9 cm for 0.2, 64.5 cm for 0.3 and 68.2 cm for 0.4. Average female lengths were 57.3 cm for 0.2, 62.7 cm for 0.3 and 66.4 cm for 0.4. Figure 1 shows this trend of increased size for older fish. The overall average weight for combined sexes was 3.5 Kg.

Timing of Returning Adults

Figure 2 and Figure 3 show the timing of the different-age fish of both sexes returning to the rack. For example, the number of 0.4 males killed each day was divided by the total number of 0.4 males returning throughout the run. On 19 July, one hundred ninety-eight 0.4 males were killed. The total 0.4 males for the whole run was 2,340, so on 19 July 8.5% of the 0.4 male component of the run returned. On 21 July, 5% more of the 0.4s returned and were killed, etc. The cumulative daily percentages are 100% within each age class and sex. As the run progressed, the 0.4 males

Table 1. Age-class composition for 1983 Hidden Falls returns.

	Males			
	0.2	0.3	0.4	Total
Rack	3,794	20,632	2,340	26,766
Lagoon excess a/	1,532	2,390	78	4,000
Bay fishery a/	3,475	5,420	177	9,072
Main fishery b/	5,402	29,379	3,353	38,134
	14,203	57,821	5,948	77,972

	Females			
	0.2	0.3	0.4	Total
Rack	724	16,527	1,236	18,487
Lagoon excess a/	705	3,245	50	4,000
Bay fishery a/	1,599	7,360	113	9,072
Main fishery b/	1,031	23,533	1,758	26,322
	4,059	50,665	3,157	57,881

Total returns to rack	45,253
lagoon excess	8,000
bay fishery	18,144
main fishery	64,456
Total returning 0.2s (1980 Brood)	18,262
Total returning 0.3s (1979 Brood)	108,486
Total returning 0.4s (1978 Brood)	9,105
Grand Total for 1983	135,853

a/ Scale samples taken from 8/12 and 8/19; assumed 1:1 sex ratio
b/ Age composition and sex ratio taken from fish returning to the hatchery rack

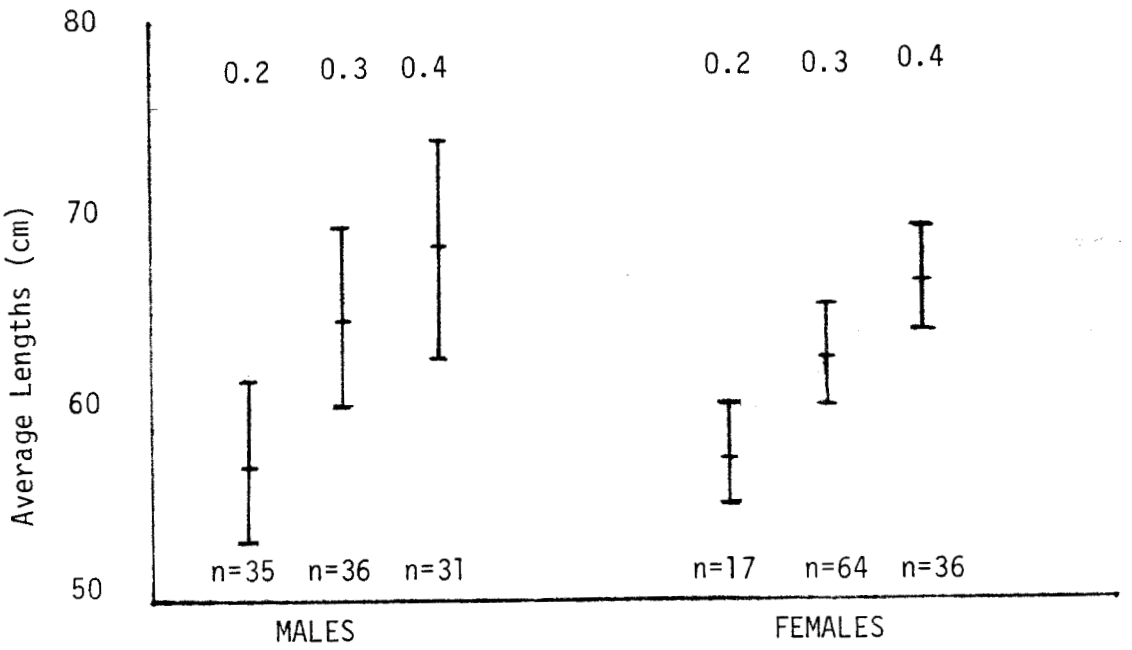

Figure 1. Lengths of chum salmon returning to Hidden Falls in 1983 by age class showing means, standard deviations, and sample size (n).

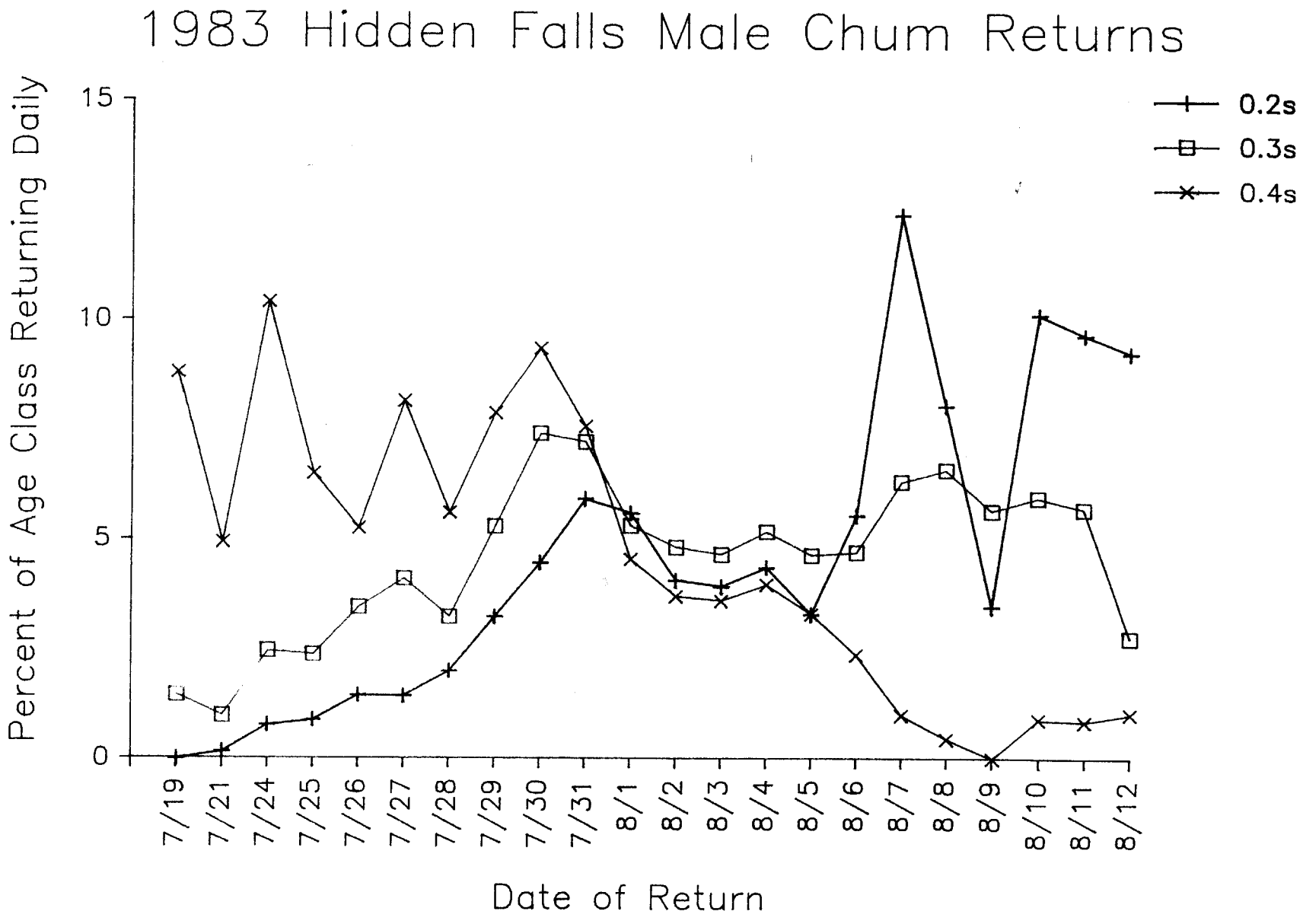

Figure 2. Daily age-class distribution for 1983 Hidden Falls male chum salmon returning to the hatchery rack.

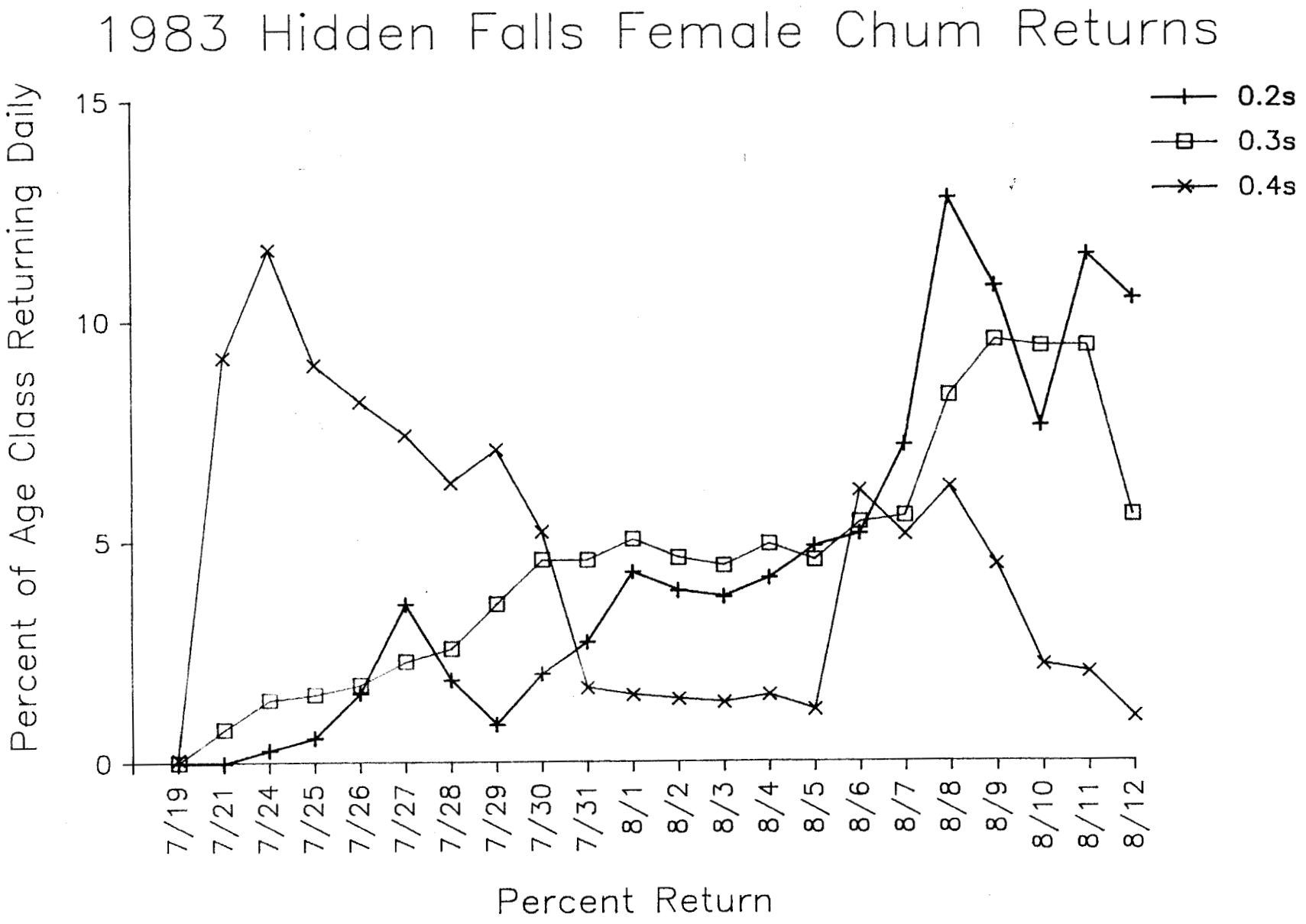

Figure 3. Daily age-class distribution for 1983 Hidden Falls female chum salmon returning ot the hatchery rack.

diminished in strength, while the 0.2 and 0.3 males increased. Females returned similarly over time. Age-0.4 females returned early and were virtually gone by 12 August, while 0.2 female percentages increased considerably during the last 6 days of egg stripping. Even though the return timing of fish from different brood years may be confusing when presented this way, the drastic yearly increase in release numbers made the comparison necessary. Fry released from the 1980 brood totaled 9 million, while 3.6 million and 1.9 million fry were released from the 1979 and 1978 broods, respectively. Before survival from each release could be calculated, the large variation in numbers of fish released from each brood made it necessary to determine age composition during each yearly return to the hatchery. Only if equal numbers of fish had been released each year and only if these fish had incurred equal marine survival rates could the survival rate of each release of juveniles have been calculated by using the age-distribution data from fish returning in any one year.

CWT Results

A total of 320 heads were taken from adipose-clipped fish, and 211 coded-wire tags were recovered. None of the fish from the 1978 brood were tagged. In 1983 tag retention for fish from the 1979 brood was 64%, up slightly from 55% in 1982 (Table 2). Tag retention for fish from 1980 brood was 85% (Table 3), indicating the tagging crew gained more experience over time with tagging large numbers of chum fry.

Summaries of tag recoveries are provided in Table 2 and Table 3. After 2 years of returns, the saltwater-rearing mode of fish from the 1979 brood had twice the tag-return rate (128 vs. 61 tags recovered/10,000 released) of the strictly freshwater-rearing mode. However, fish from the two brood stocks, Kadashan River and Clear River, showed very similar tag-return rates: 77 vs. 93

Table 2. 1979 brood Hidden Falls CWT recovery scheme.

Kadashan River (KN)	Saltwater reared	1,694,174 released
	Freshwater reared	1,725,637 released
Clear River (CR)	Freshwater reared	130,000 released

All fry released 14 May-20 May, 1980

Tag code	Brood	Rearing	Size at release (gm)	# Marked	Tags recovered 1982 Rack	1982 Fishery	1983 Rack	1983 Fishery	Total
H4-2-6	KN	saltwater net pens	2.3	10,226	40	3	91	32	166
H4-2-1	KN	freshwater	1.6	12,914	6	1	65	28	100
H4-2-5	CR	freshwater	1.4	1,508	1	0	12	1	14

Freshwater rearing 61 tags recovered/10,000 tags released

Saltwater rearing 128 tags recovered/10,000 tags released

Kadashan brood 77 tags recovered/10,000 tags released

Clear River brood 93 tags recovered/10,000 tags released

Tag retention

1982 47/86 = 55% 1983 169/262 = 64%

Table 3. 1980 brood Hidden Falls CWT recovery scheme.

Kadashan River (KN) brood origin.

Early release 2,616,981 unmarked fry
Late release 6,396,957 unmarked fry

Tag code	Lot	Rearing	Release date	Release size (gm)	# Marked	Tags recovered Rack	Fishery	Total
H4-4-6	KN1	saltwater net pens	15 April 1981	1.6	29,947	5	4	9
H4-4-5	KN1	saltwater net pens	15 May 1981	2.4	30,156	39	34	73

Early release - 3 tags recovered/10,000 tags released.
Late release - 24 tags recovered/10,000 tags released.

Tag retention

44/52 = 85%

respectively. Fry from the 1980 brood were tagged to evaluate early vs. late releases; fish released 15 May (late) returned as 0.2s in numbers that were eight times greater than the 15 April release (early) during the 1983 season: 24 vs. 3, respectively. The 15 May date approximates the normal release time for fed fry. All these tag-lot comparisons are presented as a total number of tags recovered per 10,000 tags released, which accounts for different tagged release numbers.

The survival rates by brood years are summarized in Table 4. When considering that fish were incubated in Snettisham and then moved to Hidden Falls in the spring for imprinting and short-term net-pen rearing, overall survivals were good for the first two releases (1.57% and 2.42%). The 1979 brood was the first brood incubated and reared at Hidden Falls, and the survival rate to present (3.61%, not including 0.4s) is very good.

Commercial Fishery

The first substantial fishery directed toward chum salmon returning to Hidden Falls Hatchery occurred in 1983; about 82,600 fish were caught by commercial purse seiners. Most were taken in the 17 July fishery when about 50 boats fished the area. In mid-August another 18,145 were caught by three boats when Kasnyku Bay was opened for fishing on excess, dark chum salmon. Several fish tickets from these boats showed that incorrect subdistricts were entered on their forms; i.e.; 112-16 as opposed to 112-11. The known errors have been corrected, but if they continue, this problem will make hatchery evaluation difficult.

A chum salmon that had been tagged with a Peterson disk was recovered from a seiner in Kasnyku Bay on 9 August. The fish had been tagged by Commercial Fisheries personnel in the Point Baker area (106-41) of Sumner Strait on 29 June. More disk-tag recoveries in future years would help describe southern migration

Table 4. Hidden Falls chum salmon survival rate by brood year.

	Age returning (% of release) 0.2	0.4	0.5	Return total	No. fry released	Total return %
1977 Brood	5	1,855 (0.88%)	1,480 (0.7%)	3,340	212,551	1.57
1978 Brood	1,576 (.083%)	35,011 (1.85%)	9,105 (.47%)	45,692	1,889,184	2.42
1979 Brood	21,539 (0.60%)	108,486 (3.01%)		130,025	3,599,384	3.61
1980 Brood	18,262 (0.20%)			18,262	9,013,938	.20

1977 Brood overall age composition 0.2% (0.2) 56% (0.3) 44% (0.4)
1978 Brood overall age composition 4% (0.2) 77% (0.3) 19% (0.4)

patterns, if adult chum salmon were tagged in significant numbers along with other currently targeted species.

The chum salmon returns to Hidden Falls Hatchery in 1983 were significant. They indicate a very encouraging future for enhanced chum salmon fisheries in Chatham Strait.

ACKNOWLEDGMENTS

The author wishes to thank the staff of Hidden Falls Hatchery for their efforts, particularly Jim Cochran, George Bowden, Kevin Smith, Phil Hunsicker, Gordon Garcia, and Kelly Kirkpatrick. Thanks also to Dr. Johnny Holland, Dr. Ken Leon, and Jim Cochran for their critical review of the manuscript and to Steve Schwartz for graphics help.